

REMARKS

I. Introduction

Claims 12-22 are pending in the application. In the final Office Action dated Oct. 28, 2008, the Examiner objected to claim 18 for failing to specify a unit of measure; rejected claims 12 and 15-17 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 3,585,088 ("Schwuttke"); rejected claim 14 under 35 U.S.C. § 103(a) as being unpatentable over Schwuttke in view of U.S. Pat. No. 5,405,804 ("Yabe"); and rejected claims 13 and 18-22 under 35 U.S.C. § 103(a) as being unpatentable over Schwuttke in view of U.S. Pat. No. 6,242,808 ("Shimizu"). In this Amendment, Applicants have amended claims 12 and 18, and added new claims 23-26.

II. Objection to Claim 18

Claim 18 was objected to as not specifying a unit of measure. Specifically, the Examiner asserts that a percent impurity could be percents such as weight percent, atomic percent, molar percent, or volume percent. Applicants have amended claim 18 to recite that an interconnect has a metal alloy or a doped metal impurity proportion of less than 5% by weight. Applicants request reconsideration in light of the amendment to claim 18.

III. Schwuttke and the Proposed Combinations Do Not Render Claim 12

Unpatentable

Amended independent claim 12 recites:

(b) producing a locally delimited thermal region in the finely patterned metal-containing interconnect and **moving the locally delimited thermal region in a direction of the interconnect** in such a way that a recrystallization of the interconnect is carried out for the purpose of producing an interconnect having a second grain size, the second grain size being **lengthened** with respect to the first grain size **in the direction of the movement**.

Schwuttke fails to teach this element.

Schwuttke is directed to methods of producing single crystals on supporting substrates. With respect to the element of "moving the locally delimited thermal region in a direction of the interconnect," there seems to be no dispute that Schwuttke does not

explicitly teach the motion of sweeping a heat source across a deposited material to produce a moving thermal region. However, the Examiner asserts that this type of movement is implied in Schwuttke and would be obvious to one of ordinary skill in the art who desires to recrystallize an entire area of a metal. (See Office Action dated Oct. 28, 2008, page 3). Applicants respectfully disagree.

Schwuttke discloses the use of a **pulsed** laser beam to recrystallize thick metallic layers. For example, in the first and third illustrative examples of Schwuttke, a one time irradiation (i.e., one laser pulse) of a film is disclosed, but no movement of the laser beam is taught or proposed. Similarly, in the second and fourth illustrative examples of Schwuttke, a repeated irradiation at different areas of a film is taught. However, again no movement of the laser beam is taught or proposed. Applicants note that the first, second, third, and fourth illustrative examples "illustrate preferred specific embodiments of **the method of the invention**." Schwuttke, Col. 5, lines 59-60 (emphasis added). Thus, the assertion that movement of a laser beam across a deposited material is implied in Schwuttke is unfounded. As established above, in the illustrative examples that Schwuttke has characterized as preferred specific embodiments of **the method of the invention**, there is no teaching or suggestion of movement of the laser beam. Applicants respectfully submit that the final Office Action is improperly using the present claims as a blueprint to pick and choose from the teachings of Schwuttke and supplementing that teaching with no legitimate basis to conclude that Schwuttke teaches the element of "moving the locally delimited thermal region in a direction of the interconnect." Such a conclusion is simply not warranted by the disclosure of Schwuttke.

Moreover, Applicants submit that Schwuttke may not render obvious the invention of present independent claim 12 because the problem of the present invention exists only if **finely patterned interconnect** feature sizes are used. While in the rough patterned interconnect structures according to Schwuttke a stationary, non-moving irradiation was sufficient for crystal grain enlargement, it was found by the present inventors that finely patterned interconnect structures may not be improved by such a conventional treatment as shown in Fig. 2 of the present application.

Further, Applicants maintain that Schwuttke does not teach lengthening a grain in a direction of movement as recited in claim 12 and illustrated in Fig. 3 of the present application. As explained in the present application:

The movement (e.g. 1 cm/second) of the temperature front thus produced along the interconnect 5 enables a recrystallization of the small and randomly distributed copper grains from a first grain size 5A to an enlarged second grain size 5C. More precisely, a tendency towards the production of grains that are lengthened in the direction of movement or in the direction of the interconnects 5 result in this case.

Thus, as the specification further explains, the result is reduced grain size scattering for charge carriers in the conductor and reduced resistance, higher conductivity, and improved electromigration. It will be appreciated that, the direction of the movement is essential to the invention of present independent claim 12 since only in case of a movement in a direction of the interconnect are the grain sizes lengthened within the interconnect. This permits reduced power consumption and faster clock circuits in a semiconductor circuit using the improved technique.

Such a feature is missing from, and nowhere suggested by, Schwuttke. Schwuttke acknowledges the benefit of electromigration to be had from larger grain structures. (See Col. 3, lines 42-44). However, Schwuttke relates to recrystallizing silicon or polysilicon films and the only directional aspect of recrystallization taught by Schwuttke is that "monocrystals produced by the laser beam pulse will have the same general crystal orientation" as the preferred growth direction of the crystal material, such as in the 111 plane of the silicon. Thus, Schwuttke fails to teach producing a locally delimited thermal region and moving it in a direction of the interconnect so as to recrystallize the interconnect to produce in the interconnect a second, larger grain size *which is lengthened in the direction of movement of the thermal region*.

Schwuttke fails to teach producing a locally delimited thermal region in the finely patterned metal-containing interconnect and **moving the locally delimited thermal region in a direction of the interconnect** in such a way that a recrystallization of the interconnect is carried out for the purpose of producing an interconnect having a second grain size, the second grain size being **lengthened** with respect to the first grain size **in the direction of the movement**. The Examiner has also not asserted that Yabe or Shimizu teach this element. For at least this reason, Schwuttke independently, and as

part the combinations of Schwuttke, Yabe, and Shimizu as contemplated by the Examiner, do not render amended independent claim 12 or any claim that depends on claim 12 unpatentable.

IV. Conclusion

In view of the amendments to the claims and the foregoing remarks, Applicants submit that the pending claims are in condition for allowance. Reconsideration is therefore respectfully requested. If there are any questions concerning this Response, the Examiner is asked to phone the undersigned attorney at (312) 321-4200.

Respectfully submitted,



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